Exercise-1

ONLY ONE OPTION CORRECT TYPE

SECTION (A) : AVERAGE, PEAK AND RMS VALUES

1. If the value of potential in an A.C. circuit is 10V, then the peak value of potential is -**[CPMT-2003]**

(1) $\frac{10}{\sqrt{2}}$ (2) $10\sqrt{2}$ (3) $20\sqrt{2}$ (4) $\frac{20}{\sqrt{2}}$

2. In a A.C. circuit of capacitance the phase of current from potential is - **[CPMT-2003]**

(1) Forward (2) Backward
(3) Both are in the same phase (4) None of these

3. A coil of 200 Ω resistance and 1.0 H inductance is connected to an A.C source of frequency 200/2π Hz. Phase angle between potential and current will be - **[MP PMT-2003]**

(1) 30º (2) 90º (3) 45º (4) 0º

4. The hot wire ammeter measures : **[R_PMT 2004]**

(1) D.C. current (2) A.C. Current (3) none of above (4) both (1) and (2)

5. A capacitor is a perfect insulator for :

(1) constant direct current (2) alternating current
(3) direct as well as alternating current (4) variable direct current

6. A choke coil sould have :

(1) high inductance and high resistance (2) low inductance and low resistance
(3) high inductance and low resistance (4) low inductance and high resistance

7. An AC voltage source V = $200\sqrt{2}$ sin 100 t is connected across a circuit containing an AC ammeter (it reads rms value) and capacitor of capacity 1 μF. The reading of ammeter is :

(1) 10 mA (2) 20 mA (3) 40 mA (4) 80 mA

8. Average value of A.C. current in a half time period may be :

(1) positive (2) negative (3) zero (4) All of these

9. An alternating current is given by $I = I_1 \cos\omega t + I_2 \sin\omega t$. The rms current is given by- **[MPPMT-1994]**

(1) $\frac{1}{\sqrt{2}}(I_1 + I_2)$ (2) $\frac{1}{\sqrt{2}}(I_1 + I_2)^2$ (3) $\frac{1}{\sqrt{2}}(I_1^2 + I_2^2)^{1/2}$ (4) $\frac{1}{2}(I_1^2 + I_2^2)^{1/2}$

10. The peak value of A.C. is $2\sqrt{2}$ amp., its apparent value is- (in amp.) **[RPMT-1996]**

(1) 1 (2) 2 (3) 4 (4) zero

11. r.m.s. value of current $i = 3 + 4 \sin(\omega t + \pi/3)$ is:

(1) 5 A (2) $\sqrt{17}$ A (3) $\frac{5}{\sqrt{2}}$ A (4) $\frac{7}{\sqrt{2}}$ A

12. The peak value of an alternating e.m.f E given by $E = E_0 \cos\omega t$ is 10 volt and frequency is 50 Hz. At time t = (1/600) sec, the instantaneous value of e.m.f is :

(1) 10 volt (2) $5\sqrt{3}$ volt (3) 5 volt (4) 1 volt

13. An alternating voltage is given by : $e = e_1 \sin\omega t + e_2 \cos\omega t$. Then the root mean square value of voltage is given by :

(1) $\sqrt{e_1^2 + e_2^2}$ (2) $\sqrt{e_1 e_2}$ (3) $\sqrt{\frac{e_1 e_2}{2}}$ (4) $\sqrt{\frac{e_1^2 + e_2^2}{2}}$

14. An AC voltage is given by :

$E = E_0 \sin \frac{2\pi t}{T}$

Then the mean value of voltage calculated over time interval of T/2 seconds :

(1) is always zero (2) is never zero (3) is $(2e_0/\pi)$ always (4) may be zero

15. The voltage of an AC source varies with time according to the equation, $V = 100 \sin 100 \pi t \cos 100 \pi t$. Where t is in second and V is in volt. Then :

(1) the peak voltage of the source is 100 volt (2) the peak voltage of the source is $(100/\sqrt{2})$ volt
(3) the peak voltage of the source is 50 volt (4) the frequency of the source is 50 Hz

16. An AC voltage of $V = 220\sqrt{2} \sin\left(2\pi 50 t + \frac{\pi}{2}\right)$ is applied across a DC voltmeter, its reading will be:

(1) $220\sqrt{2}$ V (2) $\sqrt{2}$ V (3) 220 V (4) zero

17. The r.m.s value of an A.C. of 50 Hz is 10 amp. The time taken by the alternating current in reaching from zero to maximum value find the peak value will be - **[Karnataka CET-2003]**

(1) 2×10^{-2} sec and 14.14 amp (2) 1×10^{-2} sec and 7.07 amp
(3) 5×10^{-3} sec and 7.07 amp (4) 5×10^{-3} sec and 14.14 amp

18. If instantaneous current is given by $i = 4 \cos(\omega t + \phi)$ amperes, then the r.m.s value of current is – **[RPET-2000]**

(1) 4 amperes (2) $2\sqrt{2}$ amperes (3) $4\sqrt{2}$ amperes (4) zero amperes

19. A 40Ω electric heater is connected to a 200V, 50 Hz mains supply. The peak value of electric current flowing in the circuir is approximately- **[MPPET-1992]**

(1) 2.5 A (2) 5.0 A (3) 7 A (4) 10 A

20. When magnet is approached near a glowing bulb, the vibrations are produced in filament carrying current, then the current through the filament is- **[DRM-1993]**

(1) D.C. (2) A.C.
(3) Mixture of A.C. and D.C. (4) Nothing can be said

21. An AC ammeter is used to measure current in a circuit. When a given direct constant current passes through the circuit, the AC ammeter reads 3 ampere. When an alternating current passes through the circuit, the AC ammeter reads 4 ampere. Then the reading of this ammeter if DC and AC flow through the circuit simultaneously, is :

(1) 3 A (2) 4 A (3) 7 A (4) 5 A

SECTION (B) : POWER CONSUMED IN AN AC CIRCUIT

1. A choke coil is preferred to a rheostat in AC circuit as :

(1) it consumes almost zero power (2) it increases current
(3) it increases power (4) it increases voltage

2. Average power consumed in an A.C. series circuit is given by (symbols have their usual meaning) :

(1) $E_{rms} I_{rms} \cos\phi$ (2) $(I_{rms})^2 R$ (3) $\frac{E_{max}^2 R}{2(|z|)^2}$ (4) All of these

3. A circuit with e.m.f. $E = 200 \sin \omega t$, contains a capacitance and inductance, then the value of power factor will be- **[RPET-1995]**

(1) 0 (2) 1 (3) 0.6 (4) 0.3

4. If a chocke coil of negligible resistance works on 220 volt source and 5m. Amp. current is flowing through it, then the loss of power in chocke coil is- **[RPMT-1995]**

(1) 0 (2) 11 watt (3) 44×10^3 watt (4) 1.1 watt

5. The value of current at half power point is- **[RPET-1995]**

(1) $I_m\sqrt{2}$ (2) $\frac{I_m}{\sqrt{2}}$ (3) $2\,I_m$ (4) $\frac{I_m}{2}$

6. Expressions for emf and current in an A.C. circuit are E = 200 sin 314 t volt and $I = 100\sin\left(314+\frac{\pi}{3}\right)$ amp. The power factor is- **[RPMT-1996]**

(1) $\frac{1}{2}$ (2) $\frac{1}{4}$ (3) 1 (4) –1

7. In a series LR circuit, the voltage drop across inductor is 8 volt and across resistor is 6 volt. Then voltage applied and power factor of circuit respectively are:

(1) 14 V, 0.8 (2) 10 V, 0.8 (3) 10 V, 0.6 (4) 14 V, 0.6

8. In an a.c. circuit the e.m. f, (e) and the corrent (i) at any instant are givan respectively by :

$e = E_0 \sin\omega t$

$i = I_0 \sin(\omega t - \phi)$

The average power in the circuit over one cycle of a.c. is : **[AIPMT 2008]**

(1) $\frac{E_0 I_0}{2}\cos\varphi$ (2) $E_0 I_0$ (3) $\frac{E_0 I_0}{2}$ (4) $\frac{E_0 I_0}{2}\sin\varphi$

9. The power factor of an A.C. circuit having resistance R and inductance L (connected in series) and an angular velocity ω is –

(1) $\frac{R}{\omega L}$ (2) $\frac{R}{(R^2+\omega^2L^2)^{1/2}}$ (3) $\frac{\omega L}{R}$ (4) $\frac{R}{(R^2-\omega^2L^2)^{1/2}}$

10. The average power delivered to a series AC circuit is given by (symbols have their usual meaning) :

(1) $E_{rms}\,I_{rms}$ (2) $E_{rms}\,I_{rms}\cos\phi$ (3) $E_{rms}\,I_{rms}\sin\phi$ (4) zero

11. The potential difference V across and the current I flowing through an instrument in an AC circuit are given by :

$V = 5\cos\omega t$ volt

$I = 2\sin\omega t$ volt

The power dissipated in the instrument is :

(1) zero (2) 5 watt (3) 10 watt (4) 2.5 watt

12. A direct current of 2 A and an alternating current having a maximum value of 2 A flow through two identical resistances. The ratio of heat produced in the two resistances in the same time interval will be:

(1) 1 : 1 (2) 1 : 2 (3) 2 : 1 (4) 4 : 1

13. A sinusoidal AC current flows through a resistor of resistance R. If the peak current is I_p, then average power dissipated is :

(1) $I_p^2 R\cos\theta$ (2) $\frac{1}{2}I_p^2 R$ (3) $\frac{4}{\pi}I_p^2 R$ (4) $\frac{1}{\pi^2}I_p^2 R$

14. What is the rms value of an alternating current which when passed through a resistor produces heat, which is thrice that produced by a current of 2 ampere in the same resistor in the same time interval?

(1) 6 ampere (2) 2 ampere (3) $2\sqrt{3}$ ampere (4) 0.65 ampere

15. If a current I given by $I_0 \sin\left(\omega t-\frac{\pi}{2}\right)$ flows in an A.C. circuit across which an A.C. potential of $E = E_0 \sin\omega t$ has been applied, then the power consumption P in the circuit will be - **[MP PET-2001,02]**

(1) $P = \frac{E_0 I_0}{\sqrt{2}}$ (2) $P = \sqrt{2} E_0 I_0$ (3) $P = \frac{E_0 I_0}{2}$ (4) P = 0

16. You have two copper cables of equal length for carrying current. One of them has a single wire of area of cross-section A, the other has ten wires of cross-section $\frac{A}{10}$ each. Judge their suitability for transporting AC and DC- **[CPMT-1994]**
(1) Only single strand for DC and only multiple strand for AC
(2) Either for DC, only multiple strands for AC
(3) Only single strand for AC, either for DC
(4) Only single strand for DC, either for AC

17. The self inductance of a choke coil is 10 mH. When it is conected with a 10V D.C. source, then the loss of power is 20 watt. When it is connected with 10 volt A.C. source loss of power is 10 watt. The frequency of A.C. source will be- **[RPMT-1995]**
(1) 50 Hz (2) 60 Hz (3) 80 Hz (4) 100 Hz

18. If the frequency of the source e.m.f. in an AC circuit is n, the power varies with a frequency :
(1) n (2) 2 n (3) n/2 (4) zero

19. A coil of inductive reactance 31Ω has a resistance of 8Ω It is placed in series with a condenser of capacitative reactance 25Ω. The combination is connected to an a.c. source of 110 volt. The power factor of the circuit is : **[AIPMT 2006]**
(1) 0.56 (2) 0.64 (3) 0.80 (4) 0.33

20. A circuit has a resistance of 12 ohm and an impedance of 15 ohm. The power factor of the circuit will be : **[AIEEE 2005; 4/300]**
(1) 0.8 (2) 0.4 (3) 1.25 (4) 0.125

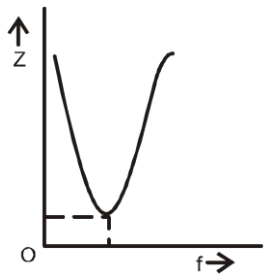
21. A coil of inductance 5.0 mH and negligible resistance is connected to an alternating voltage V = 10 sin (100 t). The peak current in the circuit will be :
(1) 2 amp (2) 1 amp (3) 10 amp (4) 20 amp

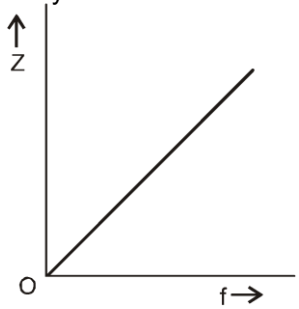
22. A resistor and a capacitor are connected to an AC supply of 200 volt, 50 Hz in series. The current in the circuit is 2 ampere. If the power consumed in the circuit is 100 watt, then the resistance in the circuit is:
(1) 100 Ω (2) 25 Ω (3) $\sqrt{125 \times 75}\Omega$ (4) 400 Ω

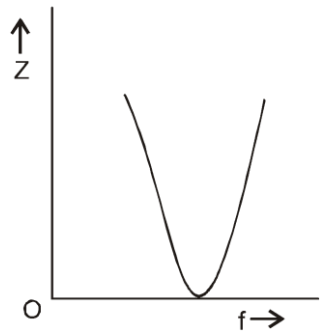
23. The impedance of a series circuit consists of 3 ohm resistance and 4 ohm reactance. The power factor of the circuit is :
(1) 0.4 (2) 0.6 (3) 0.8 (4) 1.0

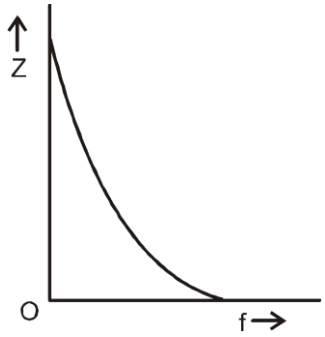
SECTION (C) : AC SOURCE WITH R, L, C CONNECTED IN SERIES

1. A series LCR circular in connected to a.c. source of variable frequency 'f'. The graphical represenration of variation of impendance 'z' of the circuit with frequency f will be **[RPMT-2014]**

(1) 

(2) 

(3) 

(4) 

2. With increase in frequency of an AC supply, the inductive reactance :
(1) decreases (2) increases directly proportional to frequency
(3) increases as square of frequency (4) decreases inversely with frequency

3. With increase in frequency of an AC supply, the capacitive reactance :
(1) varies inversely with frequency (2) varies directly with frequency
(3) varies directly as square of frequency (4) remains constant

4. In an a.c. circuit consisting of resistance R and inductance L, the voltage across R is 60 volt and that across L is 80 volt. The total voltage across the combination is
(1) 140 V (2) 20 V (3) 100 V (4) 70 V

5. An e.m.f. E = 4 cos 1000t volt is applied to an LR circuit of inductance 3mH and resistance 4Ω. The amplitude of the current in the circuit is- **[AIIMS-1994]**
(1) 1.0 A (2) 0.8 A (3) $\frac{4}{\sqrt{7}}$ A (4) $\frac{5}{7}$ A

6. A coil has reactance of 100Ω when freqency is 50 Hz. If the frequency becomes 150 Hz, then the reactance will be- **[RPMT-1995]**
(1) 100Ω (2) 300Ω (3) 450Ω (4) 600Ω

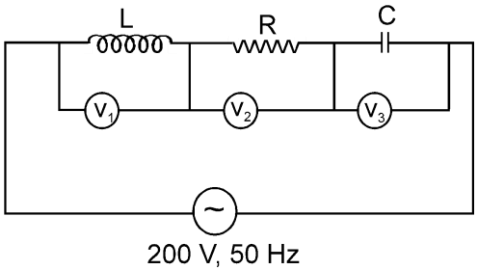
7. The current in a circuit containing a capacitance C and a resistance R in series leads over the applied voltage of frequency $\frac{\omega}{2\pi}$ by. **[REE - 1991]**
(1) $\tan^{-1}\left(\frac{1}{\omega CR}\right)$ (2) $\tan^{-1}(\omega CR)$ (3) $\tan^{-1}\left(\omega\frac{1}{R}\right)$ (4) $\cos^{-1}(\omega CR)$

8. In a circuit, an inductance of 0.1 Henry and a resistance of 1Ω are connected in series with an AC source of voltage V = 5 sin 10 t. The phase difference between the current and applied voltage will be **[REE - 1996]**
(1) π (2) 2π (3) π/4 (4) 0

9. If a resistance of 30Ω, a capacitor of reactance 20 Ω, and an inductor of inductive reactance 60Ω are connected in series to a 100 V, 50 Hz power source, then - **[REE - 94]**
(1) A current of 2.0 A flows (2) A current of 3.33 A flows
(3) Power factor of the circuit is zero (4) Power factor of the circuit is 2/5

10. The output of an AC generator is given by : $E = E_m\sin(\omega t - \pi/4)$ and current is given by $i = i_m\sin(\omega t - 3\pi/4)$. The circuit contains a single element other than the generator. It is :
(1) a capacitor. (2) a resistor.
(3) an inductor. (4) not possible to decide due to lack of information.

11. If the readings of v_1 and v_3 are 100 volt each then reading of v_2 is :



(1) 0 volt
(2) 100 volt
(3) 200 volt
(4) cannot be determined by given information.

12. In an LRC series circuit at resonance current in the circuit is $10\sqrt{2}$ A. If now frequency of the source is changed such that now current lags by 45° than applied voltage in the circuit. Which of the following is correct :
(1) Frequency must be increased and current after the change is 10 A
(2) Frequency must be decreased and current after the change is 10 A
(3) Frequency must be decreased and current is same as that of initial value
(4) The given information is insufficient to conclude anything **[Made 2006, CSS, GRSTU]**

13. In a pure inductive circuit or in an A.C. circuit containing inductance only, the current- **[UPCPMT-1990, MPPMT, RPMT-1993]**
(1) Leads the e.m.f. by 90°
(2) Lags behind the e.m.f. by 90°
(3) Sometimes leads and sometime lags behind the e.m.f.
(4) Is in phase with the e.m.f.

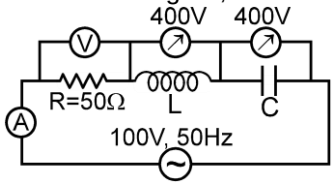
14. A series combination of R, L, C is connected to an a.c. source. If the resistance is 3Ω and the reactance is 4Ω, the power factor of the circuit is- **[CPMT-1994]**
(1) 0.4 (2) 0.6 (3) 0.8 (4) 1.0

15. A 12Ω resistor and a 0.21 henry inductor are connected in series to an AC source operating at 20 volt, 50 Hz. The phase angle between the current and the source voltage is- **[BHU-1994]**
(1) 30° (2) 40° (3) 80° (4) 90°

16. When 100 V DC is applied across a solenoid, a steady current of 1 A flows in it. When 100 V AC is applied across the same solenoid, the current drops to 0.5 A. If the frequency of the AC source is $150\sqrt{3}$ /π Hz, the impedance and inductance of the solenoid are :
(1) 200 Ω and 1/3 H (2) 100 Ω and 1/16 H
(3) 200 Ω and 1.0 H (4) 1100 Ω and 3/117 H

17. If in a series LCR AC circuit, the rms voltage across L, C and R are V_1, V_2 and V_3 respectively, then the rms voltage of the source is always :
(1) equal to $V_1 + V_2 + V_3$ (2) equal to $V_1 - V_2 + V_3$
(3) more than $V_1 + V_2 + V_3$ (4) none of these is true

18. In the series LCR circuit as shown in figure, the voltmeter and ammeter readings are :



(1) V = 100 volt, I = 2 amp (2) V = 100 volt, I = 5 amp
(3) V = 1000 volt, I = 2 amp (4) V = 300 volt, I = 1 amp

19. An AC voltage source of variable angular frequency ω and fixed amplitude V connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When ω is increased : **[JEE 2010; 3/163, –1]**

(1) the bulb glows dimmer
(2) the bulb glows brighter
(3) total impedence of the circuit is unchanged
(4) total impedence of the circuit increases

20. In a circuit L,C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45_0 The value of C is : **[AIPMT 2005]**

(1) $\frac{1}{2\pi f(2\pi fL-R)}$ (2) $\frac{1}{2\pi f(2\pi fL+R}$ (3) $\frac{1}{\pi f(2\pi fL-R)}$ (4) $\frac{1}{\pi f(2\pi fL+R)}$

21. In an LCR series a.c. circuit, the voltage across each of the components. L, C and R is 50 V. The voltage across the LC combination will be : **[AIEEE 2004, 4/300]**

(1) 50 V (2) $50\sqrt{3}$ s (3) 100 V (4) 0 V (zero)

22. The phase difference between the alternating current and emf is π/2. Which of the following cannot be the constituent of the circuit? **[AIEEE 2005; 4/300]**

(1) C alone (2) R, L (3) L, C (4) L alone

23. An alternating voltage $E = 200\sqrt{2}$ sin (100 t) is connected to a 1 microfarad capacitor through an A.C. ammeter. The reading of the ammeter shall be - **[UPSEAT-2000]**

(1) 10 mA (2) 20 mA (3) 40 mA (4) 80 mA

24. A 0.21-H inductor and a 88-Ω resistor are connected in series to a 220-V, 50-Hz AC source. The current in the circuit and the phase angle between the current and the source voltage are respectively.
Use π = 22/7.

(1) 2 A, $\tan^{-1}\frac{3}{4}$ (2) 14.4 A, $\tan^{-1}7/8$ (3) 14.4 A, $\tan^{-1}8/7$ (4) 3.28 A, $\tan^{-1}2/11$

25. An LCR series circuit with 100 Ω resistance is connected to an AC source of 200 V and angular frequency 300 radians per second. When only the capacitance is removed, the current lags behind the voltage by 60°. When only the inductance is removed, the current leads the voltage by 60º. Then the current and power dissipated in LCR circuit are respectively

(1) 1A, 200 watt. (2) 1A, 400 watt. (3) 2A, 200 watt. (4) 2A, 400 watt.

26. A 100 volt AC source of angular frequency 500 rad/s is connected to a LCR circuit with L = 0.8 H, C = 5 μF and R = 10 Ω, all connected in series. The potential difference across the resistance is

(1) $\frac{100}{\sqrt{2}}$ volt (2) 100 volt (3) 50 volt (4) $50\sqrt{3}$

27. A pure resistive circuit element X when connected to an AC supply of peak voltage 200 V gives a peak current of 5 A which is in phase with the voltage. A second circuit element Y, when connected to the same AC supply also gives the same value of peak current but the current lags behind by 90°. If the series combination of X and Y is connected to the same supply, what will be the rms value of current ?

(1) $\frac{10}{\sqrt{2}}$ amp (2) $\frac{5}{\sqrt{2}}$ amp (3) $\frac{5}{2}$ amp (4) 5 amp

28. In an L-R series circuit ($L = \frac{175}{11}$ mH and R = 12Ω), a variable emf source ($V = V_0 \sin \omega t$) of $V_{rms} = 130\sqrt{2}$ V and frequency 50 Hz is applied. The current amplitude in the circuit and phase of current with respect to voltage are respectively (Use π = 22/7)

(1) 14.14A, 30° (2) $10\sqrt{2}$ A, $\tan^{-1}\frac{5}{12}$ (3) 10 A, $\tan^{-1}\frac{5}{12}$ (4) 20 A, $\tan^{-1}\frac{5}{12}$

29. In an AC circuit, a resistance of R ohm is connected in series with an inductance L. If phase angle between voltage and current be 45°, the value of inductive reactance will be.

(1) R/4 (2) R/2
(3) R (4) cannot be found with the given data

30. In an AC circuit the potential differences across an inductance and resistance joined in series are respectively 16 V and 20 V. The total potential difference across the circuit is

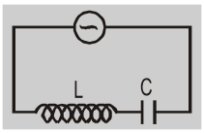
(1) 20 V (2) 25.6 V (3) 31.9 V (4) 53.5 V

31. An alternating current of frequency 'f' is flowing in a circuit containing a resistance R and a choke L in series. The impedance of this circuit is - **[RPET-2001,03]**

(1) R + 2πfL (2) $\sqrt{R^2 + 4\pi^2 f^2 L^2}$ (3) $\sqrt{R^2 + L^2}$ (4) $\sqrt{R^2 + 2\pi fL}$

32. An alternating current flows through a circuit consisting of inductance L and resistance R. Periodicity of the supply is $\frac{\omega}{2\pi}$ which of the following is true- **[MPPMT-1993]**
(1) The limiting value of impedance is L for low frequency
(2) The limiting value of impedance for high frequency is Lω
(3) The limiting value of impedance for high frequency is R
(4) The limiting value of impedance for low frequency is Lω

33. In following diagram voltage on L and C is- **[UPPMT-1993]**



(1) In same phase (2) With phase angle of 90°
(3) In phase angle of 180° (4) It will depends on the value of L and C

34. An LCR series circuit is connected to a source of alternating current. At resonance, the applied voltage and the current flowing through the circuit will have a phase difference of- **[CPMT-1994]**
(1) π (2) $\frac{\pi}{2}$ (3) $\frac{\pi}{4}$ (4) 0

35. Same current is flowing in two alternating circuits. The first circuit contains only inductance and the other contains only a capacitor. If the frequency of the e.m.f. is increased, the effect on the value of the current will be- **[MPPET-1993]**
(1) increase in first circuit and decrease in the other
(2) increase in both circuits
(3) decrease in both circuits
(4) decrease in first circuit and increase in other

36. Energy dissipates in LCR circuit in :
(1) L only (2) C only (3) R only (4) all of these

37. A coil has an inductance of $\frac{2.2}{\pi}$ H and is joined in series with a resistance of 220 Ω. When an alternating e.m.f. of 220 V at 50 cps is applied to it, then the wattless component of the rms current in the circuit is
(1) 5 ampere (2) 0.5 ampere (3) 0.7 ampere (4) 7 ampere

38. An electric bulb and a capacitor are connected in series with an AC source. On increasing the frequency of the source, the brightness of the bulb :
(1) increase (2) decreases
(3) remains unchanged (4) sometimes increases and sometimes decreases

39. By what percentage the impedance in an AC series circuit should be increased so that the power factor changes from (1/2) to (1/4) (when R is constant) ?
(1) 200% (2) 100% (3) 50% (4) 400%

SECTION (D) : RESONANCE

1. The self inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of : **[AIEEE 2005, 4/300]**
(1) 4μF (2) 8μF (3) 1μF (4) 2μF

2. In an LCR circuit, capacitance is changed from C to 2C. For the resonant frequency to remain unchanged, the inductance should be changed from L to : **[AIEEE 2004; 4/300]**
(1) 4L (2) 2L (3) L/2 (4) L/4

3. In an oscillating LC circuit the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is : **[AIEEE 2003; 4/300]**
(1) Q/2 (2) Q/$\sqrt{3}$ (3) Q/$\sqrt{2}$ (4) Q

4. What is the value of inductance L for which the current is a maximum in a series LCR circuit with C =10 μ F and ω= 1000 radian/s? **[AIPMT 2007]**
(1) 10 mH (2) 100mH
(3) 1 mH (4) cannot be calculated unless R is Known

5. A transistor – oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f. If L is doubled and C is changed to 4C, then frequency will be: **[AIPMT 2006]**
(1) $\frac{f}{4}$ (2) 8 f (3) $\frac{f}{2\sqrt{2}}$ (4) $\frac{f}{2}$

6. A 2μF capacitor is initially charged to 20 Volts and then shorted across a 8 μH inductor. The maximum value of the current in the circuit is :
(1) 10.0 A (2) 7.5 A (3) 12.0 A (4) 8.2 A

7. For an A.C. circuit at the condition of resonance- **[RPET-1996]**
(1) impedance = R
(2) impedance = $\left(\omega L - \frac{1}{\omega C}\right)$
(3) potential difference across L and C in same phase.
(4) The current and emf are having a phase difference ϕ.

8. A series A.C. circuit consist of an inductor and a capacitor. The inductance and capacitance is respectively. 1 henry and 25 μF. If the current is maximum in circuit then angular frequency will be- **[RPMT-1999]**
(1) 200 (2) 100 (3) 50 (4) $\frac{200}{2\pi}$

9. The value of power factor cosϕ in series LCR circuit at resonance is :
(1) zero (2) 1 (3) 1/2 (4) 1/2 ohm

10. A series LCR circuit containing a resistance of 120 ohm has angular resonance frequency $4 \times 10_3$ rad s_{-1}. At resonance, the voltage across resistance and inductance are 60V and 40 V respectively. The values of L and C are respectively :
(1) 20 mH, 25/8 μF (2) 2mH, 1/35 μF (3) 20 mH, 1/40 μF (4) 2mH, 25/8 nF

11. In an LCR circuit, the capacitance is made one-fourth, when in resonance. Then what should be the change in inductance, so that the circuit remains in resonance ?
(1) 4 times (2) 1/4 times (3) 8 times (4) 2 times

12. A resistor R, an inductor L and a capacitor C are connected in series to an oscillator of frequency n. If the resonant frequency is n_r, then the current lags behind voltage, when :
(1) n = 0 (2) $n < n_r$ (3) $n = r_r$ (4) $n > n_r$

13. A 10 ohm resistance 0.5 mH coil and 10μF capacitor are joined in series when a suitable frequency of alternating current source is joined to this combination, the circuit resonates. If the resistance is halved the resonance frequency- **[MPPET-1995]**
(1) is halved (2) is doubled (3) remains unchanged (4) is quadrupled

14. At a frequency more than the resonance frequency, the nature of an anti-resonant cicuit is- **[RPMT-1996]**
(1) resistive (2) capacitive (3) inductive (4) all of the above

15. If resonance frequency is f and then the capacity is increased 4 times, then new resonance frequency becomes- **[RPMT-1996]**
(1) $\frac{f}{2}$ (2) 2f (3) f (4) $\frac{f}{4}$

SECTION (E) : TRANSFORMER

1. The core of any transformer is laminated so as to : **[AIEEE 2003, 4/300]**

(1) reduce the energy loss due to eddy currents

(2) make it light weight

(3) make is robust and strong

(4) increase the secondary voltage

2. In a transformer, number of turns in the primary are 140 and that in the secondary are 280. If current in primary is 4 A, then that in the secondary is :(assume that the transformer is ideal) **[AIEEE 2002; 4/300]**

(1) 4 A (2) 2 A (3) 6 A (4) 10 A

3. A transformer is used for a 100 watt, 20 volt electric bulb at a place where the A.C. mains potential is 200 volt and the current drawn is 0.6 A. The efficiency of the transformer is nearly

(1) 48% (2) 68% (3) 30 % (4) 83%

4. In a step-up transformer the turns ratio is 10. If the frequency of the current in the primary coil is 50 Hz then the frequency of the current in the secondary coil will be

(1) 500 Hz (2) 5 Hz (3) 60 Hz (4) 50 Hz

5. A power (step up) transformer with an 1 : 8 turn ratio has 60 Hz, 120 V across the primary; the load in the secondary is $10_4\ \Omega$. The current in the secondary is

(1) 96 A (2) 0.96 A (3) 9.6 A (4) 96 mA

6. A transformer is used to light a 140 watt, 24 volt lamp from 240 V AC mains. The current in the main cable is 0.7 amp. The efficiency of the transformer is :

(1) 48% (2) 63.8% (3) 83.3% (4) 90%

7. In a step-up transformer the voltage in the primary is 220 V and the current is 5A. The secondary voltage is found to be 22000 V. The current in the secondary (neglect losses) is

(1) 5 A (2) 50 A (3) 500 A (4) 0.05 A

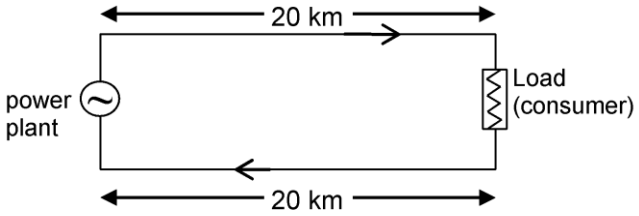
8. The core of a transformer is laminated to reduce

(1) eddy current loss (2) hysteresis loss (3) copper loss (4) magnetic loss

Paragraph for Questions 9 and 10

A thermal power plant produces electric power of 600 kW at 4000 V, which is to be transported to a place 20 km away from the power plant for consumers' usage. It can be transported either directly with a cable of large current carrying capacity or by using a combination of step-up and step-down transformers at the two ends. The drawback of the direct transmission is the large energy dissipation. In the method using transformers, the dissipation is much smaller. In this method, a step-up transformer is used at the plant side so that the current is reduced to a smaller value. At the consumers' end, a step-down transformer is used to supply power to the consumers at the specified lower voltage. It is reasonable to assume that the power cable is purely resistive and the transformers are ideal with a power factor unity. All the currents and voltages mentioned are rms values.

[JEE(Advanced)-2013; 3/60]]



9. If the direct transmission method with a cable of resistance 0.4 Ω km^{-1} is used, the power dissipation (in %) during transmission is :

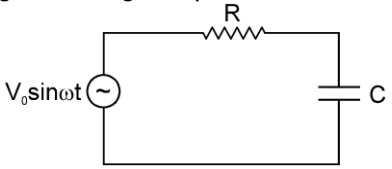
(1) 20 (2) 30 (3) 40 (4) 60

10. In the method using the transformers, assume that the ratio of the number of turns in the primary to that in the secondary in the step-up transformer is 1 : 10. If the power to the consumers has to be supplied at 200V, the ratio of the number of turns in the primary to that in the secondary in the step-down transformer is :

(1) 200 : 1 (2) 150 : 1 (3) 100 : 1 (4) 50 : 1

Exercise-2

1. An ac voltage source $V = V_0 \sin \omega t$ is connected across resistance R and capacitance C as shown in figure. It is given that $R = \frac{1}{\omega C}$. The peak current is I_0. If the angular frequency of the voltage source is changed to $\frac{\omega}{\sqrt{3}}$, keeping the voltage amplitude constant, then the new peak current in the circuit is :



(1) $\frac{I_0}{2}$ (2) $\frac{I_0}{\sqrt{2}}$ (3) $\frac{I_0}{\sqrt{3}}$ (4) $\frac{I_0}{3}$

2. An AC voltage source of variable angular frequency ω and fixed amplitude V connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When ω is increased : **[JEE 2010; 3/163, –1]**

(1) the bulb glows dimmer (2) the bulb glows brighter
(3) total impedence of the circuit is unchanged (4) total impedence of the circuit increases

3. Alternating current cannot be measured by D.C. ammeter because : **[AIEEE 2004; 4/300]**
(1) A.C. current pass through d.C. ammeter
(2) A.C. change direction
(3) average value of current for complete cycle is zero
(4) D.C. ammeter will get damaged

4. The overall efficiency of a transformer is 90%. The transformer is rated for an output of 9000 watt. The primary voltage is 1000 volt. The ratio of turns in the primary to the secondary coil is 5 : 1. The iron losses at full load are 700 watt. The primary coil has a resistance of 1 ohm.

(i) The voltage in secondary coil is :
(1) 1000 volt (2) 5000 volt (3) 200 volt (4) zero volt

(ii) In the above, the current in the primary coil is :
(1) 9 amp (2) 10 amp (3) 1 amp (4) 4.5 amp

(iii) In the above, the copper loss in the primary coil is :
(1) 100 watt (2) 700 watt (3) 200 watt (4) 1000 watt

(iv) In the above, the copper loss in the secondary coil is :
(1) 100 watt (2) 700 watt (3) 200 watt (4) 1000 watt

(v) In the above, the current in the secondary coil is :
(1) 45 amp (2) 46 amp (3) 10 amp (4) 50 amp

(vi) In the above, the resistance of the secondary coil is approximately :
(1) 0.01 Ω (2) 0.1 Ω (3) 0.2 Ω (4) 0.4 Ω

Exercise-3

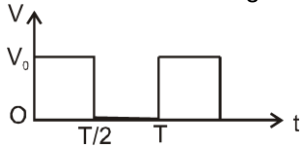
PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. Power dissipated in an LCR series circuit connected to an a.c.source of emf is : **[AIPMT 2009]**

(1) $\varepsilon^2 R/\{R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\}$ (2) $\varepsilon^2 R/\sqrt{\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}$

(3) $\varepsilon^2/\sqrt{\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}\,R$ (4) $\frac{\varepsilon^2\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}{R}$

2. The r.m.s. value of potential difference V shown in the figure is : **[AIPMT (MAINS) 2011]**



(1) V_0 (2) $V_0/\sqrt{2}$ (3) $V_0/2$ (4) $V_0/\sqrt{3}$

3. A coil has resistance 30 ohm and inductive reactance 20 Ohm at 50 Hz frequency. If an ac source, of 200 volt, 100 Hz, is connected across the coil, the current in the coil will be : **[AIPMT (MAINS) 2011]**

(1) 4.0 A (2) 8.0 A (3) $\frac{20}{\sqrt{13}}$ A (4) 2.0 A

4. In an electrical circuit R,L, C and an a.c. voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage the current in the circuit is $\pi/3$. If instead, C is removed from the circuit, the phase difference is again $\pi/3$. The power factor of the circuit is : **[AIPMT_(Pre)_2012]**

(1) 1/2 (2) $1/\sqrt{2}$ (3) 1 (4) $\sqrt{3}/2$

5. The instantaneous values of alternating current and voltages in a circuit are given as

$i = \frac{1}{\sqrt{2}}\sin(100\pi t)\text{amper}$ **[AIPMT 2012 (Mains)]**

$e = \frac{1}{\sqrt{2}}\sin(100\pi t + \pi/3)\text{Volt}$

The average power in Watts consumed in the circuit is :

(1) $\frac{1}{4}$ (2) $\frac{\sqrt{3}}{4}$ (3) $\frac{1}{2}$ (4) $\frac{1}{8}$

6. A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when : **[NEET-2013]**

(1) number of turns in the coil is reduced.
(2) a capacitance of reactance $X_C = X_L$ is included in the same circuit
(3) an iron rod is inserted in the coil
(4) frequency of the AC source is decreased

7. A resistance 'R' draws power 'P' when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes 'Z', the power drawn will be: **[AIPMT-2015]**

(1) $P\sqrt{\frac{R}{Z}}$ (2) $P\left(\frac{R}{Z}\right)$ (3) P (4) $P\left(\frac{R}{Z}\right)^2$

8. An inductor 20 mH, a capacitor 50 μF and a resistor. 40Ω are connected in series across a source of emf V = 10 sin 340t. The power loss in A.C. circuit is **[AIPMT-2016]**

(1) 0.89 W (2) 0.51 W (3) 0.67W (4) 0.76W

9. A small signal voltage $V(t) = V_0 \sin\omega t$ is applied across an ideal capacitor C :

(1) Current I(t), leads voltage V(t) by 180°
(2) Current I(t), lags voltage V(t) by 90°
(3) Over a full cycle the capacitor C does not consume any energy from the voltage source.
(4) Current I(t) is in phase with voltage V(t) **[AIPMT-2016]**

10. Which of the following combinations should be selected for better tuning of an L-C-R circuit used for communication? **[NEET-2016]**

(1) R = 25 Ω, L = 1.5 H, C = 45 μF (2) R = 20 Ω, L = 1.5 H, C = 35 μF
(3) R = 25 Ω, L = 2.5 H, C = 45 μF (4) R = 15 Ω, L = 3.5 H, C = 30 μF

11. The potential differences across the resistance, capacitance and inductance are 80 V, 40 V and 100 V respectively in an L-C-R circuit. The power factor of this circuit is **[NEET-2016]**

(1) 1.0 (2) 0.4 (3) 0.5 (4) 0.8

12. A 100 Ω resistance and a capacitor of 100 Ω reactance are connected in series across a 220 V source. When the capacitor is 50% charged, the peak value of the displacement current is **[NEET-2016]**

(1) $11\sqrt{2}A$ (2) 2.2 A (3) 11 A (4) 4.4 A

13. A inductor 20 mH a capacitor 100 μF and a resistor 50 Ω are connected in series across a source of emf, V = 10 sin 314 t. The power loss in the circuit is : **[NEET-2018]**
(1) 0.79 W (2) 1.13 W (3) 2.74 W (4) 0.43 W

14. A circuit when connected to an AC source of 12 V gives a current of 0.2A. The same circuit when connected to a DC source of 12 V, gives a current of 0.4 A. The circuit is : **[NEET-2019-II]**
(1) series LR (2) series RC (3) series LC (4) series LCR

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. In a series LCR circuit R = 200 Ω and the voltage and the frequency of the main supply is 220 V and 50 Hz respectively. On taking out the capacitance from the circuit the current lags behind the voltage by 30º. On taking out the inductor from the circuit the current leads the voltage by 30º. The power dissipated in the LCR circuit is **[AIEEE 2010; 4/144, –1]**
(1) 305 W (2) 210 W (3) Zero W (4) 242 W

2. An arc lamp requires a direct current of 10 A at 80 V to function. if it is connected to a 220 V(rms), 50 Hz AC supply, the series inductor needed for it to work is close to : **[JEE Main 2016; 4/120, –1]**
(1) 0.08 H (2) 0.044 H (3) 0.065 H (4) 80 H

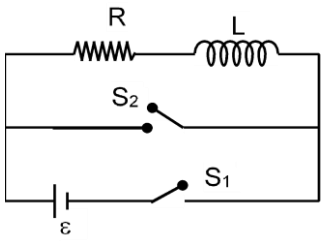
3. For an RLC circuit driven with voltage of amplitude υ_m and frequency $\omega_0 = \frac{1}{\sqrt{LC}}$ the current exhibits resonance. The quality factor, Q is given by : **[JEE-Main-2018]**
(1) $\frac{R}{(\omega_0 C)}$ (2) $\frac{CR}{\omega_0}$ (3) $\frac{\omega_0 L}{R}$ (4) $\frac{\omega_0 R}{L}$

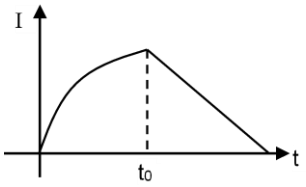
4. In an a.c circuit, the instantaneous e.m.f and current are given by
e = 100 sin 30t
i = 20 sin $\left(30t - \frac{\pi}{4}\right)$
In one cycle of a.c the average power consumed by the circuit and the wattless current are, respectively:
[JEE-Main-2018]
(1) $\frac{50}{\sqrt{2}}, 0$ (2) 50,0 (3) 50,10 (4) $\frac{1000}{\sqrt{2}}, 10$

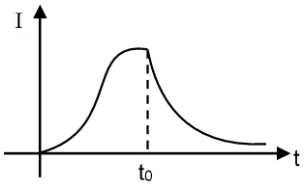
5. A power transmission line feeds input power at 2300 V to a step down transformer with its primary windings having 4000 turns. The output power is delivered at 230 V by the transformer. If the current in the primary of the transformer is 5A and its efficiency is 90%, the output current would be :
[JEE-Main-2019]
(1) 45 A (2) 25 A (3) 35 A (4) 50 A

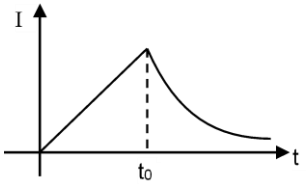
6. A series AC circuit containing an inductor (20 mH), a capacitor (120 μF) and a resistor (60Ω) is driven by an AC source of $\frac{24\,V}{50\,Hz}$. The energy dissipated in the circuit in 60 s is : **[JEE-Main-2019]**
(1) 3.39×10^3 J (2) 5.65×10^2 J (3) 5.17×10^2 J (4) 2.26×10^3 J

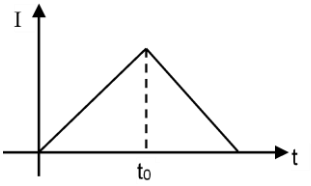
7. In the circuit shown the switch S_1 is closed at time t = 0 and the switch S_2 is kept open. At some later time (t_0), the switch S_1 is opened and S_2 is closed. The behavior of the current I as a function of time 't' given by : **[JEE-Main-2019]**



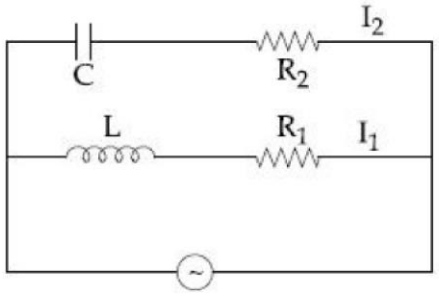
(1)


(2)


(3)


(4)


8. In the above circuit $C = \frac{\sqrt{3}}{2}mF, R_2 = 20\Omega$ $L = \frac{\sqrt{3}}{10}H$ and $R_1 = 10\Omega$. Current in L-R_1 path is I_1 and in C-R_2 path it is I_2. The voltage of A.C. source is given by $V = 200\sqrt{2}\sin(100t)$ volts, the phase difference between I_1 and I_2 is : **[JEE-Main-2019]**



(1) 60º (2) 0º (3) 30º (4) 90º

Answers

EXERCISE - 1

SECTION (A)

1.	(2)	**2.**	(1)	**3.**	(3)	**4.**	(4)	**5.**	(1)	**6.**	(3)	**7.**	(2)
8.	(4)	**9.**	(3)	**10.**	(2)	**11.**	(2)	**12.**	(2)	**13.**	(4)	**14.**	(4)
15.	(3)	**16.**	(4)	**17.**	(4)	**18.**	(2)	**19.**	(3)	**20.**	(2)	**21.**	(4)

SECTION (B)

1.	(1)	**2.**	(4)	**3.**	(1)	**4.**	(1)	**5.**	(2)	**6.**	(1)	**7.**	(3)
8.	(1)	**9.**	(2)	**10.**	(2)	**11.**	(1)	**12.**	(3)	**13.**	(2)	**14.**	(3)
15.	(4)	**16.**	(2)	**17.**	(3)	**18.**	(2)	**19.**	(3)	**20.**	(1)	**21.**	(4)
22.	(2)	**23.**	(2)										

SECTION (C)

1.	(1)	**2.**	(2)	**3.**	(1)	**4.**	(3)	**5.**	(2)	**6.**	(2)	**7.**	(1)
8.	(3)	**9.**	(1)	**10.**	(3)	**11.**	(3)	**12.**	(1)	**13.**	(2)	**14.**	(2)
15.	(3)	**16.**	(1)	**17.**	(4)	**18.**	(1)	**19.**	(2)	**20.**	(2)	**21.**	(4)
22.	(2)	**23.**	(2)	**24.**	(1)	**25.**	(4)	**26.**	(2)	**27.**	(3)	**28.**	(4)
29.	(3)	**30.**	(2)	**31.**	(2)	**32.**	(2)	**33.**	(3)	**34.**	(4)	**35.**	(4)
36.	(3)	**37.**	(2)	**38.**	(1)	**39.**	(2)						

SECTION (D)

1.	(3)	**2.**	(3)	**3.**	(3)	**4.**	(2)	**5.**	(3)	**6.**	(1)	**7.**	(1)
8.	(1)	**9.**	(2)	**10.**	(1)	**11.**	(1)	**12.**	(4)	**13.**	(3)	**14.**	(3)
15.	(1)												

SECTION (E)

1.	(1)	**2.**	(2)	**3.**	(4)	**4.**	(4)	**5.**	(4)	**6.**	(3)	**7.**	(4)
8.	(1)	**9.**	(4)	**10.**	(1)								

EXERCISE - 2

1. (2) **2.** (2) **3.** (3) **4.** **(i)** (3) **(ii)** (2) **(iii)** (1) **(iv)** (3) **(v)** (2) **(vi)** (2)

EXERCISE - 3

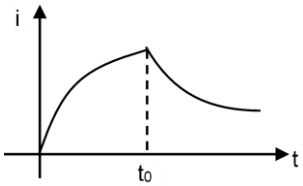
PART – I

1.	(2)	**2.**	(2)	**3.**	(1)	**4.**	(3)	**5.**	(4)	**6.**	(3)	**7.**	(4)
8.	(2)	**9.**	(3)	**10.**	(4)	**11.**	(4)	**12.**	(2)	**13.**	(1)	**14.**	(1)

PART – II

1.	(4)	**2.**	(3)	**3.**	(3)	**4.**	(4)	**5.**	(1)
6.	(3)								

7. (Bonus) , the correct graph will be



8. (4)